

1. A method for providing improved GTP path integrity assurance in a UMTS/GPRS network, the method comprising:
defining a path based on a first node IP address, a second node IP address and a UDP port number;
receiving, at a first node, a first GTP message from a second node;
extracting one or more of: the first node IP address, the second node IP address and the UDP Port number, from the first GTP message;
determining an operational state of the path based on the first received message; and
storing the operational state of the path in a path integrity table, in association with the path definition and a time stamp related to a time the first GTP message was received.

2. The method of claim 1 wherein defining the path based on the first node IP address, the second node IP address and the UDP port number comprises:

defining a static path based on a static first node IP address, a static second node IP address and a static UDP port number; and

storing the static path definition as a path entry in the path integrity table.

3. The method of claim 1 wherein defining the path based on the first node IP address, the second node IP address and the UDP port number comprises:

defining a dynamic path based on a dynamic first node IP address, a dynamic second node IP address and a UDP port number.

4. The method of claim 1 further comprising:

determining a difference between a value of the time stamp and a current time; and

transmitting a GTP Echo Request message from the first node to the second node, using the UDP port number and using the first node IP address as a source address and the second node IP address as

a destination address, if the difference between the value of the time stamp and the current time is greater than a predetermined refresh time.

5. The method of claim 1 wherein receiving, at the first node, the first GTP message from the second node comprises:

receiving a message selected from: a Create PDP Context Request message, a GTP Echo Request message, a Create PDP Context Response message a GTP User datagram and a Gratuitous GTP Echo Response message.

6. The method of claim 1 further comprising:

receiving, at the first node, a second GTP message from the second node;

extracting the first node IP address from the second GTP message;

extracting the second node IP address from the second GTP message;

extracting the UDP port number from the second GTP message;

determining the path definition based on the first node IP address, the second node IP address and the UDP port number;

determining an operational state of the path based on the second received message;

updating the operational state entry associated with the path definition in the path integrity table; and

updating the time stamp with a value related to a time the second GTP message was received.

7. The method of claim 4 further comprising:

determining that the second node has not responded to the transmitted GTP Echo Request message;

determining an operational state of the path to be --Disabled-- based on the determination that the second node has not responded to the transmitted GTP Echo Request message;

updating the operational state entry associated with the path definition in the path integrity table to be --Disabled--; and

updating the time stamp with a value related to the determination that the second node has not responded to the transmitted GTP Echo Request message.

8. The method of claim 7 further comprising:

setting a path disabled time stamp entry to a value related to the determination that the second node has not responded to the transmitted GTP Echo Request message.

9. The method of claim 8 further comprising:

comparing the value of the path disabled time stamp entry to a current time, thereby determining a path disabled duration; and

deleting the path definition and associated information from the path integrity table if the path disabled duration is greater than a predefined path disabled duration limit.

10. The method of claim 4 further comprising:

determining that a GTP Echo Response was not received;
updating the operational state of the path to be --unknown--;

and

transmitting a second GTP Echo Request message from the first node to the second node, using the port number and using the first node IP address as a source address and the second node IP address as a destination address.

11. The method of claim 1 further comprising:

extracting a Restart Counter value from the first GTP message; and

storing the Restart Counter value, in association with the path definition in the path integrity table.

12. The method of claim 1 further comprising:

storing an administrative state of the path, in association with the path definition in the path integrity table.

13. The method of claim 1 further comprising:
receiving administrative state information regarding the path;
and
storing the administrative state information in an administrative state entry in the path integrity protocol table in association with the path definition.

14. The method of claim 1 further comprising:
consulting the path integrity table to determine the operational state of the path before attempting to set up a GTP tunnel on the path; and
choosing an alternate route for the GTP tunnel if the path integrity table indicates the path is disabled or unknown.

15. A method for providing improved GTP path integrity assurance in a UMTS/GPRS network, the method comprising:
receiving GTP messages;
building a path integrity table of records from information included in the GTP messages, each record in the path integrity table including a path definition, an operational state entry and a time stamp entry, the path definition including at least a source IP address, a destination IP address and a port number, the operational state entry having a value selected from --Enabled--, --Disabled-- and --Unknown--, the time stamp entry having a value indicative of a time information in the record was last updated;
updating records in the path integrity table when additional GTP messages associated with path definitions having records in the table are received based on information included in the additional messages, or when expected messages are not received, updating the records based on the lack of reception of the expected messages; and

making information in the path integrity table available to call processing and OAM subsystems of the GPRS network.

16. The method of claim 15 wherein receiving GTP messages comprises receiving messages selected from: Create PDP Context Request messages, GTP Echo Request messages, receiving GTP Echo Response messages, Create PDP Context Response messages, GTP User datagrams and Gratuitous GTP Echo Response messages.

17. The method of claim 15 further comprising:
receiving administrative state information regarding the path;
storing the administrative state information in an administrative state entry in the path integrity protocol table in association with the path definition; and
transmitting a Gratuitous GTP Echo Response message.

18. The method of claim 15 wherein updating records in the path integrity table comprises:
comparing values of the time stamp entries of records in the table to a current time to determine ages of the records ;
transmitting a GTP Echo Request to the destination IP address and port number associated with any record having an age greater than a desired record age limit, the GTP Echo Request including the source IP address associated with the record; and
updating the entries of the any record based on a received GTP Echo Response associated with the GTP Echo Request or on a lack thereof.

19. The method of claim 18 wherein updating the entries of the any record comprises:
receiving the GTP Echo Response message; and
updating the operational state entry to --Enabled-- and the time stamp entry to a time associated with the GTP Echo Response message.

20. The method of claim 18 wherein updating the entries of the any record comprises:

- determining that the GTP Echo Response message was not received;
- comparing a retry counter value to a retry limit;
- transmitting another GTP Echo Request message if the retry counter value is less than the retry limit;
- incrementing the retry counter; and
- updating the operational state entry to --Unknown--.

21. The method of claim 18 wherein updating the entries of the any record comprises:

- determining that the GTP Echo Response message was not received;
- comparing a retry counter value to a retry limit;
- updating the operational state entry to --Disabled-- if the retry counter value is equal to or greater than the retry limit; and
- updating the time stamp entry to a time associated with the updating of the operational state entry to --Disabled--.

22. The method of claim 21 further comprising:

- setting a path disabled time stamp entry associated with the path definition in the path integrity table to a time associated with the updating of the operational state entry to --Disabled--.

23. The method of claim 22 further comprising:

- comparing the value of the path disabled time stamp entry to a current time, thereby determining a path disabled duration; and
- deleting the record associated with the path definition from the path integrity table if the path disabled duration is greater than a predefined path disabled time limit.

24. A UMTS/GPRS network node comprising:

main network node functional blocks;

a GTP Echo Request/Response processor that is operative to transmit GTP Echo Requests to other nodes in a UMTS/GPRS network when directed to do so by other components of the UMTS/GPRS network node and receive and process GTP Echo response messages from the other nodes in the UMTS/GPRS network as directed by the other components of the UMTS/GPRS network node;

a path integrity protocol module that is operative to build a path integrity protocol table by extracting path integrity information from network message traffic associated with the node and record the extracted information in the path integrity protocol table, update the information recorded in the table by extracting updated path integrity information from additional network message traffic associated with the node and recording the extracted updated information in the table, monitor the age of recorded information stored in the table and update old information in the table by directing the GTP Echo Request/Response processor to transmit GTP Echo Requests over paths associated with the old table information and to provide information to the path integrity protocol module regarding the reception or lack of reception of GTP Echo Response messages associated with the GTP Echo Requests, the path integrity protocol module being further operative to replace the old recorded information with new information based on the information provided to the path integrity protocol module by the GTP Echo Request/Response processor.

25. The UMTS/GPRS network node of claim 24 wherein the main network node functional blocks comprise functional blocks selected from: Radio Node Controller main functional blocks, Serving GPRS Support Node main functional blocks and Gateway GPRS Support Node main functional blocks.

26. The UMTS/GPRS network node of claim 24 wherein the path integrity protocol module is operative to build a path integrity protocol table by extracting path integrity information from at least one of Create PDP Context Request message traffic, GTP Echo Request message

traffic, GTP Echo Response message traffic, Create PDP Context Response message traffic and GTP User datagram message traffic.

27. The UMTS/GPRS network node of claim 24 wherein the path integrity protocol module is further operative to build a path integrity protocol table by extracting path definition and path operational status information from the network message traffic associated with the node and record the extracted information in the path integrity protocol table.

28. The UMTS/GPRS network node of claim 27 wherein the path integrity protocol module is further operative to build a path integrity protocol table by extracting path definition information including a source IP address, a destination IP address and a port number from the network message traffic associated with the node.

29. The UMTS/GPRS network node of claim 27 wherein the path integrity protocol module is further operative to build a path integrity protocol table by extracting Restart Counter information from the network message traffic and storing the Restart Counter information in association with the extracted path definition information.

30. The UMTS/GPRS network node of claim 24 wherein the path integrity protocol module is further operative to delete path information from the path integrity table when an operational status of the path associated with the path information has been --disabled-- for longer than a path disabled duration limit.

31. The UMTS/GPRS network node of claim 24 wherein the path integrity protocol module is further operative to accept manual path definition entries and include records associated with the manual path definition entries in the path integrity protocol table.

32. The UMTS/GPRS network node of claim 24 wherein the path integrity protocol module is further operative accept manually entered

administrative state information associated with a path definition record, and update an administrative state entry in the path integrity protocol table associated with the path definition record according to the manually entered administrative state information.